Annual O&M Report for Operable Unit 2

Fall 2013
Libby Asbestos Superfund Site
Libby, MT

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March 2014

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1 Section 1: Introduction

This report documents the first annual operation and maintenance (O&M) inspection conducted in October 2013 for Libby Asbestos Superfund Site Operable Unit 2 (OU2). The EPA declared OU2 operational and functional (O&F) on August 1, 2013, prompting the start of O&M activities. A synopsis of what O&M entails for a Superfund Site can be found in the following guidance document: *Operation and Maintenance in the Superfund Program* (May 2001) OSWER 9200.1-37FS, EPA 540-F-01-004.

1.1 Libby OU2 – Former Screening Plant

The OU2 site, known as the former Screening Plant and Surrounding Properties, is located about five miles northeast of the city of Libby, Montana on the east side of the Kootenai River and at the confluence of Rainy Creek and the Kootenai River. The OU2 site was historically owned by W.R. Grace Company (Grace) and used for stockpiling, staging, and distributing vermiculite and vermiculite concentrate to vermiculite processing areas and insulation distributors outside of the city of Libby.

OU2 is separated into several distinct impacted areas. As depicted in Figure 1 in Appendix A, these areas include the former Screening Plant (northwestern section), the Flyway (southern section), and the Rainy Creek Road Frontages (northeastern section). The Highway 37 right-of-way (ROW) adjacent to the OU2 site was included because of its proximity to the OU2 site and the known contamination in the ROW. For the purposes of this report, the contaminated portion of the Highway 37 ROW is considered part of the sections or subareas mentioned above. These subareas are described in more detail in the *Libby OU2 O&M Plan* (July 2013).

1.1.1 Documents and Records

Documents considered in the preparation of this report include the Libby OU2 O&M Plan, Remedial Action Report, and Record of Decision (ROD). These can be found on the EPA's Libby website at the following URL: http://www2.epa.gov/region8/libby-ou-documents#tabs-2. The contents of the Administrative Record for OU2 are available from the EPA Info Center in Libby, MT and the EPA Region 8 Records Center (Denver, CO).

1.1.2 Administrative Issues

There are no administrative issues on this operable unit at this time. A post-construction risk assessment has been completed and commented on by the Montana Department of Environmental Quality (DEQ), the Asbestos Technical Review Workgroup (TRW), and the Libby Asbestos Technical Advisory Group (LATAG), and has been posted to the EPA website (see the URL above). In addition to the post-construction report, an accelerated five-year review (FYR) will be conducted for OU1 and OU2 in 2014 to determine protectiveness of the remedy.

2 Remedy Performance

An O&M inspection was conducted on October 24, 2013 by Mike Cirian, Field Team Lead for the Libby Site, and Elizabeth Fagen, Remedial Project Manager for Libby OU4 (residential and commercial properties in and around the city of Libby). Inspection photos can be found in Appendix B (map of photo locations can be found in Figure 2 of Appendix A).

2.1 Soil Containment Remedy Review

The containment system in place is a clean backfill soil cover, from a source outside the Libby Valley, which creates a barrier between any residual asbestos-containing soil and the air. This meets the remedial action objective of preventing direct contact with a contaminated source, further confirmed by post-construction activity-based sampling results that detect no asbestos fibers in air. For more information on the remedy for OU2 and figures delineating the depth of contamination, please refer to the *Libby OU2 Final Remedial Action Report* (May 2012).

2.2 Remedy Effectiveness

Mike Cirian and Elizabeth Fagen reported no observable failures in the soil cover. Although minimal erosion was identified, there were no breaches and growth of vegetation over the soil cover indicates no further erosion is likely. There have been no changes in land use since the ROD.

These conclusions were reached by using the Recommended EPA O&M/Remedy Evaluation Checklist (part of guidance found on EPA's website at http://www.epa.gov/superfund/cleanup/postconstruction/operate.htm). See completed checklist in Appendix C.

2.3 Erosion Repair

During the O&M inspection, it was found that some areas of the Flyway property near the river had eroded out. Mike Cirian contacted W.R. Grace/Remedium about the discovery and they contracted Mike Chapman of Chapman Construction to perform erosion repairs. Chapman used backfill material mixed with rock to restore the eroded area and then laid down erosion matting to prevent additional erosion. Two types of matting were chosen: hay bales and coconut matting. After that, the backfill was covered with hay or straw and seeded to promote vegetation growth. This will form a cover to prevent further erosion. Photos of the repair work and finished repairs are in Appendix D.

3 O&M and Institutional Controls

O&M includes institutional controls (ICs), which are non-engineered instruments, such as administrative and legal controls, that help minimize the potential for human exposure to contamination and/or protect the integrity of the remedy. ICs play an important role in site remedies because they reduce exposure to contamination by limiting land or resource use and guide human behavior at a site.

3.1 O&M Costs

Since this is the first annual O&M report, there are no costs for the previous year (2013). For fiscal year 2014, the inspection (approximately two hours) and the report drafting (approximately 10 hours) are the only costs. Inspections will be conducted annually. For estimated future O&M costs for the EPA and Montana DEQ, please refer to the *Libby OU2 O&M Plan* (July 2013), see Section 5: Cost Estimate.

3.2 Institutional Controls

One important IC at OU2 involves the agreement with the Montana one-call utility locate service, otherwise known as U-Dig. U-Dig is a free local service for people, to locate underground utility hazards (e.g., electrical lines, waterlines) before digging at their property. The U-Dig system provides information on known or potential areas of subsurface asbestos contamination at OU2 to anyone conducting work on a property. U-Dig calls and information requests have been transitioned to the Lincoln County Asbestos Resource Program. This program provides advice on how to address contamination and helps manage any site contamination encountered. There were zero U-Dig calls concerning OU2 in 2013.

A second IC is the Montana Department of Transportation encroachment permit for the Libby Asbestos Superfund Site area, issued for any right-of-ways or easements. Zero encroachment permits were sought for OU2 properties in 2013. More information on ICs for OU2 can be found in the *Libby OU2 Institutional Control Implementation and Assurance Plan* (November 2013).

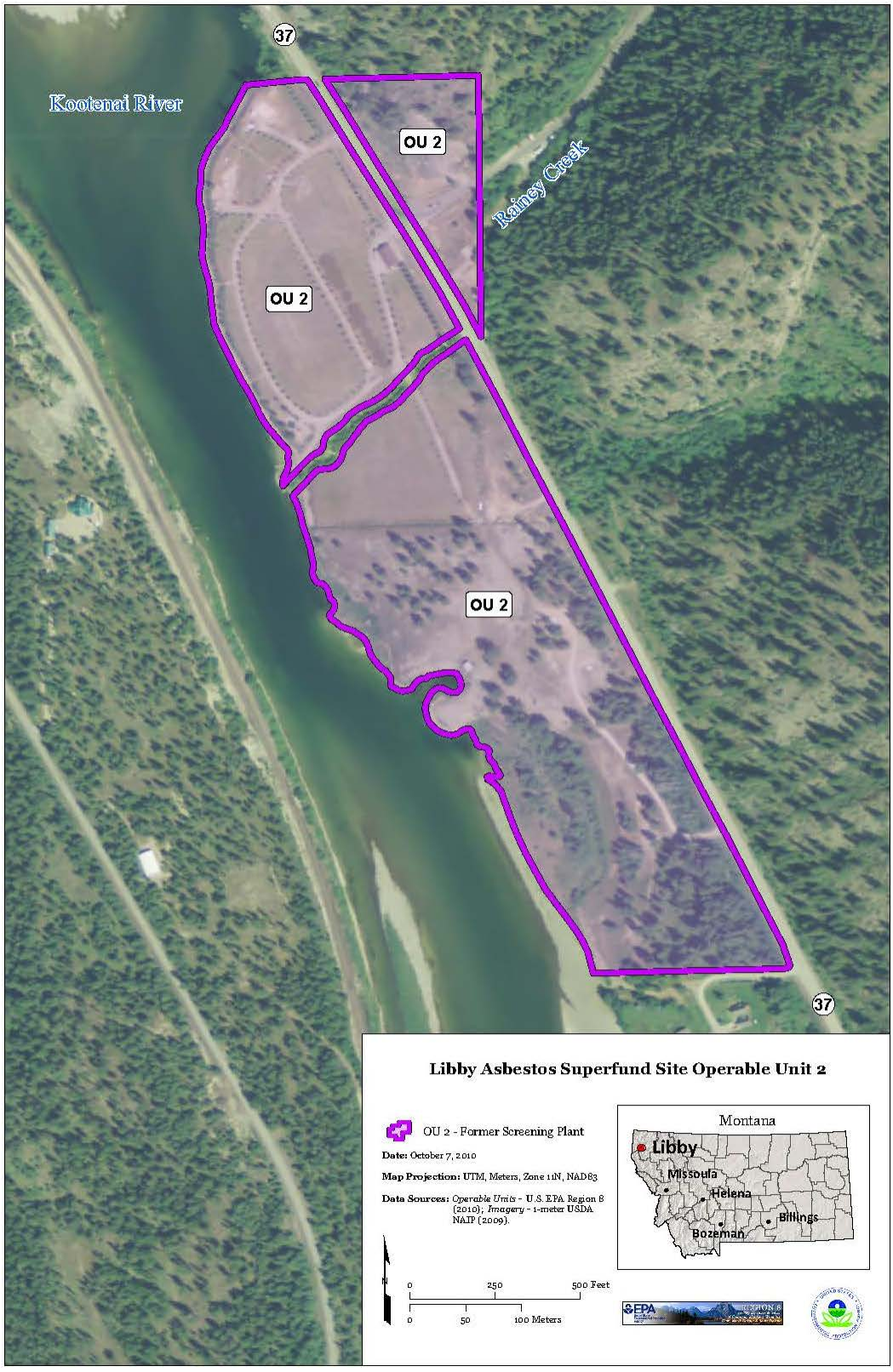
The ICs described above are adequate to minimize the potential for human exposure and to protect the remedy. Montana DEQ may choose to implement an environmental covenant pursuant to MCA 75-10-727 on any property in OU2 as an additional IC.

4 Next Steps/Recommendations

The O&M inspection concluded that no maintenance is required at OU2, so the next steps for this project include IC monitoring and routine O&M inspections. Also, a five year review for OU1 and OU2 will be conducted in 2014. The next O&M inspection for OU2 will occur in the fall of 2014.

Appendices

Appendix A: Map of Operable Unit 2



Appendix B: List of Photos with Location Descriptions

Figure B-1: Map of Photo Locations

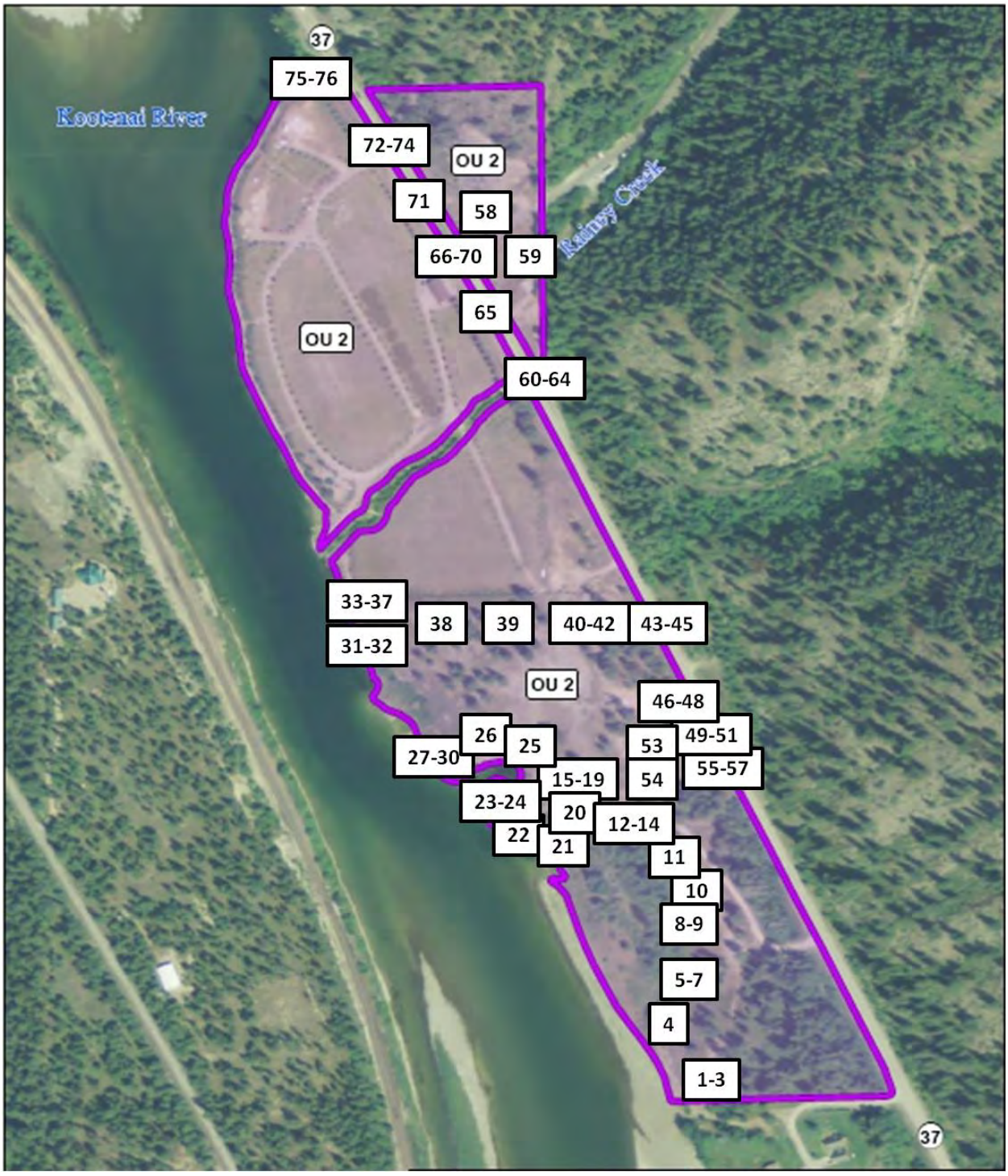


Photo 1: South corner of flyway, looking downstream

Photo 2: South corner of flyway, looking north

Photo 3: South corner of flyway, looking northeast

Photo 4: Close up of river bank at the flyway, note the dense vegetation

Photo 5: West boundary at the flyway

Photo 6: West boundary at the flyway

Photo 7: West boundary at the flyway

Photo 8: Close up of vegetation at the flyway

Photo 9: Close up of vegetation at the flyway

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Photo 17: Middle portion of the flyway, looking east

Photo 18: Middle portion of the flyway, looking northeast

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Photo 21: Old erosion near the river

Photo 22: Old erosion near the river

Photo 23: On west portion of the flyway, looking northwest

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Photo 26: Old erosion near the river

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Photo 28: On west portion of the flyway, looking northeast

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Photo 30: On west portion of the flyway, looking east

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Photo 59: Mine road looking north along Hwy 37

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Photo 61: Rainy creek area from the right of way

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Photo 63: Rainy creek area from the right of way

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Photo 65: Right of way east Parker's property

Photo 66: Parker's access gate

Photo 67: Parker's access gate

Photo 68: Right of way east Parker's property

Photo 69: View onto Parker's property from the right of way

Photo 70: View onto Parker's property from the right of way

Photo 71: View onto Parker's property from the right of way

Photo 72: View onto Parker's property from the right of way

Photo 73: View south along Hwy 37 right of way

Photo 74: View onto Parker's property from the right of way

Photo 75: North end of Parker's property along the Kootenai River

Photo 76: North end of Parker's property along the Kootenai River

Appendix C: Annual O&M/Remedy Evaluation Checklist

RECOMMENDED ANNUAL O&M /REMEDY EVALUATION CHECKLIST

Introduction and Purpose

Effective operation and maintenance (O&M) at Superfund sites generally is critical to ensure that remedies remain protective of human health and the environment.

The recommended Annual O&M Remedy Evaluation Checklist has been designed to help the Remedial Project Manager (RPM) capture data routinely collected during O&M in a way that can better evaluate the efficiency and effectiveness of the remedial action. This recommended checklist may also be used to evaluate an operating remedy prior to transferring the site to the State for O&M. In addition, remedy performance summarized using this recommended checklist can be used to communicate remedy progress to the local community, highlight potential issues before they become problems and help the RPM complete five-year reviews more efficiently.

The information that you collect using this recommended form should help you answer the following questions:

- Is the remedy achieving the remedial action objectives (RAOs), maintaining cleanup goals and/or achieving technology-specific performance goals?
- If the remedy is not achieving the established objectives and goals, what must I do to correct this and how can I document this?
- If the remedy is achieving the performance goals, objectives and performance standards, are there any opportunities to optimize the remedy to make it work more efficiently?

This recommended checklist is intended to be completed annually. It is recommended that any data that you use to complete this evaluation be attached to the checklist, as this will make completing the next year's evaluation easier.

This recommended checklist does not recommend the level of review carried out in the U.S. Environmental Protection Agency (EPA) five-year review process. However the recommended checklist contains review elements that are consistent with a five-year review process.

Instructions:

The recommended checklist is in Microsoft Word and was designed to be completed electronically. Most questions involve a short answer, yes/no response or simply checking the box. Questions that involve a short answer will have an expandable text box. For responses that ask to you to "select one," please double click on "select one" and choose the correct answer. If the information is not available for a particular question, please indicate this with a N/A. A site visit is strongly encouraged, but not required prior to completing the recommended checklist.

1. This evaluation is intended to be completed yearly once O&M activities have begun at a site and can be stored and maintained in an electronic format.
2. For large complex sites, consider completing a separate checklist for each Operable Unit (OU).
3. This evaluation should be based on information and documentation (e.g., O&M reports and monitoring data) that is readily available to the RPM.
4. Section VIII, "Technical Data and Remedy Performance," provides specific instructions regarding what data and information are important for this section. Data entered in Section VIII are used to evaluate the specific technology used in that remedial action (RA). Please note: *Section VIII, Appendix E, Other Remedy Types/Components* was designed to be used by the RPM for the annual review of O&M remedies and remedy components that are not addressed in Appendices A through D or by the separate *Recommended Annual O&M Remedy Evaluation Checklist for Contaminated Sediment Remedies*, OSWER #9355.0-118.
5. When you have completed the recommended checklist, please sign and date page 1 and place the completed document in the site file. Additionally, we recommend that you save the completed checklist electronically for use in completing the next year's evaluation.

Generally, including the Recommended Annual O&M/Remedy Evaluation Checklist in the site repository can provide the community with information about O&M status and remedy performance and can demonstrate that the Region is tracking performance to ensure that the remedy remains protective.

Acronym List			
AS	Air Sparging	PCOR	Preliminary Close Out Report
CSM	Conceptual Site Model	PRGs	Preliminary Remediation Goals
GAC	Granular Activated Carbon	PRP	Potentially Responsible Party
ICs	Institutional Controls	RAO	Remedial Action Objective
LEL	Lower Explosive Limit	ROD	Record of Decision
LTRA	Long-Term Response Action	RPM	Remedial Project Manager
MNA	Monitored Natural Attenuation	RSE	Remediation System Evaluation
NPL	National Priorities List	SVE	Soil Vapor Extraction
O&F	Operational and Functional	TI Waivers	Technical Impracticability Waivers
O&M	Operation and Maintenance	USACE	U.S. Army Corps of Engineers
OSHA	Occupational Safety and Health Administration	VEB	Vertical Engineered Barrier
OU	Operable Unit	VOCs	Volatile Organic Compounds

RECOMMENDED ANNUAL O&M /REMEDY EVALUATION CHECKLIST

Please save electronically and send this completed checklist and any attachments to the site file and site repository.

I. SIGNATURES AND APPROVALS					
RPM			**RPM (If appropriate)**		
Name:	Liz Fagen		Name:	Mike Cirian	
Telephone:	406-293-6194		Telephone:	406-293-6194	
Signature:		Date:10/24/13	Signature:		Date:10/24/13
State Contact (if appropriate)					
Name:	Dania Zinner, EPA				
Telephone:	303-312-7122				
Signature:		Date:2014			

II. GENERAL SITE INFORMATION			
Site Name:	Libby Asbestos Project Operable Unit 2		
State:	Montana		
Period Covered:	to		EPA Site ID:
Site Lead:	Fund	Other, specify:	
Organization responsible for O&M operations:	State in-house		
Other, specify:			
Site Remedy Components (ref. Section VIII):			
Preliminary Close Out Report (PCOR) date:			
Operational & Functional (O&F) date:	8/1/2013		
Last five-year review date:			
NPL deletion date:			
Did you make a site visit during this review?	☒ Yes ☐ No		Date: 10/24/2013
If no, why:			
Date of next planned checklist evaluation:			
Location of Administrative Record/Site Files:	Libby Info Center		
During the site visit, was monitoring equipment operational?			☐ Yes ☐ No ☒ N/A
Please elaborate: No monitoring equipment in place			
Has an Optimization Study been conducted at the site?	☒ N/A ☐ Yes ☐ No		Date:
If not, is one planned?			

List all site events since the last evaluation that impact or may impact remedy performance.
Chronology of events since last report (e.g., site visits, receipt of reports, equipment failures, shutdowns, vandalism, storm events):
Elaborate on significant site events or visits to site:

III. DOCUMENTS AND RECORDS Because these documents may be required for the five-year review, verify what documents are currently available on-site, or note off-site location:				
Document	**Required**	**Not required**	**On-site**	**Off-site (indicate where)**
O&M Manual	☐	☐	☐	☒
O&M Maintenance Logs	☐	☐	☐	☒
O&M Annual Reports	☐	☐	☐	☒
RA as-built drawings modified during O&M	☐	☐	☐	☒
Site-Specific Health and Safety Plan	☐	☐	☐	☒
Contingency/Emergency Response Plan	☐	☐	☐	☒
O&M/Occupational Safety and Health Administration (OSHA) Training Records	☐	☐	☐	☒
Settlement Monument Records	☐	☐	☐	☒
Gas Generation Records	☐	☒	☐	☐
Ground Water Monitoring Records	☐	☒	☐	☐
Surface Water/Sediment/Fish Monitoring Records**	☐	☐	☐	☒
Cap/Cover System Inspection Records	☐	☐	☐	☒
Leachate Extraction Records	☐	☒	☐	☐
Discharge Compliance Records	☐	☒	☐	☐
Institutional Controls (ICs) Review	☐	☒	☐	☐
Other(s) (Please name each)	☐	☒	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐

** Note: A separate O&M checklist has been developed for surface water/sediment remedies. For completeness, answer this question regarding documentation requirements and availability, and enter more detailed information in the surface water/sediment checklist.

IV. ADMINISTRATIVE ISSUES Check all that apply:	Date Initiated:
☐ Explanation of Significant Differences in progress	
☐ Record of Decision (ROD) Amendment in progress	
☐ Site in O&F period	
☐ Long-Term Response Action (LTRA) in progress	
☐ LTRA Transition to O&M in progress	
☐ Notice of Intent to Delete site in progress	
☐ Partial Site Deletion in progress	
☐ Technical Impracticability (TI) Waivers in progress	
☐ Reuse Assessment or Reuse Plan in progress	
☐ Revised Risk Assessment in progress ☐ Ecological OR ☐ Human Health	
☒ Other administrative issues:Post-construction risk assessment	

VI. O&M COSTS The purpose of this section is to document what is known about O&M costs for this site. It is realized that not all cost information will be readily available, but to the extent possible, please provide the following information, as this will help identify cost increases and flag potential budget issues before they arise.	
What was the total annual O&M cost for the previous year?	N/A
What is the expected total annual O&M cost for the upcoming year?	See O&M plan.
Please provide an approximate breakout of the previous year's O&M costs below.	**Use either $ or %**
Analytical (e.g., lab costs):	
Materials (e.g., treatment chemicals, cap materials):	
Oversight (e.g., project management):	
Monitoring (e.g., ground water sampling):	
Utilities (e.g., electric, gas, phone, water):	
ICs (implementation and enforcement):	
Other (e.g., capital improvements, equipment repairs):	
Describe any unanticipated/unusually high or low O&M costs and potential future O&M funding issues.	

VII. INSTITUTIONAL CONTROLS (ICs)**

The purpose of the IC evaluation at the O&M phase is to determine if the ICs are implemented, effective and durable. The following references may be useful for completing this evaluation:

- *Institutional Controls Bibliography: Institutional Control, Remedy Selection, and Post Construction Completion Guidance and Policy* (OSWER 9355.0110, December 2005);
- *Supplement to the Comprehensive Five-Year Review Guidance; Evaluation of Institutional Controls* (OSWER 9355.7-12, working draft 3/17/05);
- *National IC Strategy to Ensure Institutional Controls Implementation at Superfund Sites* (OSWER 9355.0-106, September 2004); and
- *Institutional Controls: A Site Manager's Guide to Identifying, Evaluating and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanup* (OSWER 9355.0-7-4FS-P, September 2000).

** Note: A separate O&M checklist has been developed for surface water/sediment remedies. For completeness, answer this question regarding ICs, and enter more detailed information in the surface water/sediment checklist.

Identify each IC (media, objective, and instrument) implemented/to be implemented at the site. Attach an extra sheet if necessary. U-Dig, Lincoln County ARP	
Are the ICs adequate to minimize the potential for human exposure and protect the integrity of the remedy? If no, please explain.	☒ Yes ☐ No
Please identify the party responsible for compliance and enforcement of the IC. Lincoln County	
Please describe what the ICs are intended to accomplish, who they are designed to inform, the source document for the IC, and where the IC information is located.	
Please identify the date when the ICs were implemented. If the ICs have yet to be implemented, please identify the party responsible for implementing the ICs and the scheduled implementation date. Restrictive covenant on Flyway.	
If the ICs have been implemented, are they still in place? If the ICs remain in place, please identify whether there is a planned termination date and, if so, what it is. No planned termination date.	
Are there reasons to clarify or modify the appropriate decision document(s) to improve the effectiveness and/or durability of the ICs? If yes, please explain and describe any plans to clarify/modify the document(s).	☐ Yes ☒ No

VIII. TECHNICAL DATA AND REMEDY PERFORMANCE

The purpose of this section is to help prompt questions about remedy performance over the past year, the adequacy of monitoring activities to assess remedy performance, and changes in field conditions or understanding that could affect the remedy. Specific sections also prompt questions about remedy optimization. Addressing these questions on an annual basis can help to flag opportunities and potential issues to watch in the coming year and help inform future improvements in remedy O&M. The collection of annual checklists can also serve as documentation of when a potential issue was first identified, what was done to address it, and when it was addressed. Thus, an annual checklist can be a useful, succinct source of information to help RPMs recount O&M history.

Questions for specific remedy types (e.g., ground water pump-and-treat) are contained in Appendices A through D at the end of the form. Appendix E contains general questions that can be used to document technical data and remedy performance for remedies and remedy components that do not fit within the specific categories identified in the remainder of this checklist. Identify the remedy types in Section VIII.A, below, and complete a copy of each appendix that is applicable to the site. If the site includes multiple remedies or remedy components of the same type, please complete a copy of the applicable appendix for each remedy/component (e.g., if the remedy includes two separately managed containment areas, complete two copies of Appendix C, one for each area). A separate O&M checklist has been developed for surface water/sediment remedies and remedy components. If the site includes a surface water/sediment remedy, note this below and complete the surface water/sediment checklist.

A. Please identify the type(s) of remedy(ies) this Annual O&M Remedy Evaluation Checklist addresses:

- ☐ Ground Water Pump-and-Treat (please complete Appendix A)
- ☐ Ground Water Monitored Natural Attenuation (MNA) (please complete Appendix B)
- ☐ Ground Water or Soil Containment (please complete Appendix C)
- ☐ Soil Vapor Extraction/Air Sparging (please complete Appendix D)
- ☒ Other Remedy Types (please complete Appendix E)

IX. RECOMMENDATIONS

New Recommendations, from this annual review:

Recommendation	Party Responsible	Milestone Date
None		

APPENDICES

TECHNICAL DATA AND REMEDY PERFORMANCE ANNUAL O&M /REMEDY EVALUATION CHECKLIST

RECOMMENDED APPENDIX A. GROUND WATER PUMP-AND-TREAT REMEDIES

The following checklist is an abbreviated set of questions that could be used by an EPA RPM for annually reviewing the O&M of a ground water pump-and-treat remedy, including pump-and-treat remedies designed for hydraulic containment. This checklist was developed using concepts presented in EPA guidance, *Elements for Effective Management of Operating Pump and Treat Systems* (EPA 542-R-02-009, December 2002). This guidance is part of a series of fact sheets that EPA OSRTI has prepared as guidance to the ground water remediation community on effectively and efficiently designing and operating long-term ground water remedies. For more information, including the guidance *O&M Report Template for Ground Water Remedies (with Emphasis on Pump and Treat Systems)* (EPA 542-R-05-010, April 2005) and report *Pilot Project to Optimize Superfund-Financed Pump and Treat Systems: Summary Report and Lessons Learned* (EPA 542-R-02-008a), visit EPA's CLU-IN Website (www.cluin.org/).

A. Remedy Goals and Conceptual Site Model (CSM)

1. Review of the current remedy goals and measurements: Remedy goals may be expressed in terms of a broad, long-term purpose or intent specified in a decision document (e.g., cleanup to a specified concentration), a performance-based metric or milestone intermediate in duration (e.g., a 20% decrease in monthly influent concentrations within 24 months of operation); or a specific and short-term objective (e.g., demonstration of plume containment).

List the short-term objectives and intermediate system goals:	
List the final system goals:	
What metrics (performance criteria) are being implemented to measure project progress towards meeting each goal?	
What schedule has been established for measuring and reporting each metric?	
Based on new information or events since the last O&M review, is there a reason to re-evaluate the system goals? Note: this might be due to factors such as regulatory framework has been revised; better technology/strategy alternatives available; existing goals appear unrealistic; costs greater than originally anticipated; extent of plume has changed; new sources of contamination removed and/or discovered; or land use or ground water production near site has changed. If yes, identify the remedy goals that should be re-evaluated, the rationale, and any plans for re-evaluating the goals.	☐ Yes ☐ No

2. Review of changes to the CSM: The CSM is a combination of text and figures that describe the hydrogeologic system, the cause of the ground water impacts, and the fate and transport of the ground water contaminants. If monitoring data during active remediation do not agree with expectations, this could point to a gap in the conceptual model that should be addressed with a focused investigation. This does not imply a return to the "remedial investigation" phase. The CSM should evolve over time, including during active remediation, as more information about the site becomes available. The following questions may be used to evaluate the need for updating the CSM:

Since the last time you completed the O&M checklist for this system, have new contaminant sources been identified or have previously suspected contaminant sources been eliminated from further consideration? If yes, use this space to comment.	☐ Yes ☐ No
Since the last time you completed an O&M checklist for this system, have new contaminants been identified in the ground water that could affect remedy effectiveness? If yes, use this space to comment.	☐ Yes ☐ No
Based on your answers to the above questions, would it be useful to update the CSM at this time?	☐ Yes ☐ No

If yes, please describe any plans to update the CSM.	

B. Remedy Performance Assessment

1. Evaluate remedy effectiveness: The following questions are intended to review whether the ground water pump-and-treat remedy is performing as intended and whether there are opportunities for optimizing the remedy.

Plume Capture

When addressing these questions, it may be useful to refer to *A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems* (EPA 600/R-08/003, January 2008).

Has a three-dimensional target capture zone been clearly defined? If no, use this space to explain why not.	☐ Yes ☐ No
If not clearly defined, describe plans to better define the target capture zone.	
What lines of evidence have been used to evaluate actual capture achieved (e.g., flow budget and/or capture zone width calculations, potentiometric surface maps, water elevation pairs, concentration trends at wells beyond the target capture zone, particle tracking in conjunction with ground water modeling, tracer tests)	

System Equipment/Structures (e.g., extraction wells, collection systems)

Since the last time you completed an O&M checklist for this system, has the downtime associated with non-routine operations and maintenance exceeded expectations? If yes, what systems have been responsible for unplanned downtime (e.g., extraction pumps, wastewater facilities)? If yes, what corrections have been or are being made to minimize downtime?	☐ Yes ☐ No
Since the last time you completed the O&M checklist for this remedy/remedy component, have any major repairs to the pump-and-treat system(s) been required? If yes, describe the repairs, their impact on progress toward remediation milestones, and actions taken to minimize similar repairs in the future.	☐ Yes ☐ No
Since the last time you completed an O&M checklist for this system, have the extraction/injection well rates changed significantly? If yes, describe the known/suspected source of the change, if identified. If yes, is the change reflective of a long-term condition and, if so, how will this be addressed in the O&M of the system?	☐ Yes ☐ No
Since the last time an O&M checklist was completed for this system, have air emissions from the system met permit requirements, if any? If not, what is being done to meet the permit requirements?	☐ Yes ☐ No ☐ N/A
Since the last time an O&M checklist was completed for this system, has effluent discharge met permit requirements? If not, what was (is) the problem and what was (or will be) done to correct it?	☐ Yes ☐ No

Optimization

Has an optimization study been conducted for this system?	☐ Yes ☐ No
If an optimization study has been conducted, have any of the optimization recommendations been implemented since the last time an O&M checklist was completed for this system?	☐ Yes ☐ No ☐ N/A
If optimization recommendations have been implemented (during this or prior review periods), describe any new results observed or conclusions drawn since the last time an O&M checklist was completed for this system.	
If optimization recommendations have not been implemented, why not?	

2. Evaluate collection and analysis of performance monitoring data	
Do the approaches used to interpret ground water monitoring data (e.g., concentration trend analyses, plume contour and/or bubble maps, plume cross-sections, potentiometric surface maps) provide adequate information to assess the performance of the pump-and-treat remedy? If no, describe plans, if any, to implement new approaches.	☐ Yes ☐ No
Based on information collected since the last O&M review, is there a need to re-evaluate the parameters, sampling methods, sampling frequency, and monitoring locations used to evaluate remedy performance?	☐ Yes ☐ No
Are ground water data managed electronically? If no, use this space to explain why not.	☐ Yes ☐ No
Are performance-monitoring reports of sufficient quality and frequency to evaluate the efficacy of the remedy and recognize protectiveness problems in time for effective action? If no, what actions, if any, have been taken or are planned to address this situation?	☐ Yes ☐ No
C. Cost Effectiveness	
Are actual parameters consistent with design parameters (based on process monitoring)? If not, how do they differ? (check all that apply) ☐ Influent rate to treatment plant ☐ Influent concentrations ☐ Mass loading to the system ☐ Removal efficiency for each treatment component ☐ Air to water ratio (air strippers) ☐ Materials usage (e.g., granular activated carbon (GAC), chemicals) ☐ Other (please explain)	☐ Yes ☐ No
Based on the above comparisons, have any above ground systems or process monitoring procedures been evaluated/implemented to reduce costs? If yes, please identify which of the following have been done to reduce costs. (check all that apply) ☐ Ensuring proper maintenance and efficiency of equipment ☐ Replacing treatment components with alternate technologies (e.g., replace UV/Oxidation with air stripping) or more appropriately sized components ☐ Eliminating unnecessary or redundant treatment components that are no longer needed (e.g., metals removal or GAC polishing system) ☐ Changing discharge ☐ Automating system to reduce labor ☐ Optimizing ground water extraction rates and/or locations ☐ Other (please explain)	☐ Yes ☐ No
D. Remedial Decisions: Indicate which of the following remedial decisions is appropriate at the present time and provide the basis for the decision.	
☐ No Change to the System ☐ Modify/Optimize System ☐ Modify/Optimize Monitoring Program ☐ IC Modifications ☐ Implementation of Contingency/Alternative Remedy	
Basis for decision:	

RECOMMENDED APPENDIX B. GROUND WATER MONITORED NATURAL ATTENUATION (MNA) REMEDIES

The following checklist is an abbreviated set of questions that could be used by an EPA RPM for annually reviewing the O&M of a MNA remedy for ground water. This MNA guidance checklist was developed using concepts presented in EPA guidance, *Performance Monitoring of MNA Remedies for* [volatile organic compounds] *(VOCs) in Ground Water* (EPA/600/R-04/027; April 2004). For some approaches, a more detailed remedy optimization study or remediation system evaluation (RSE) may be beneficial. For guidance on remedy optimization studies or RSEs, visit EPA's CLU-IN Website (www.cluin.org/) or the U.S. Army Corps of Engineers (USACE) Hazardous, Toxic and Radioactive Waste Center of Expertise RSE Website (www.environmental.usace.army.mil/)

A. Remedy Goals and Conceptual Site Model (CSM)	
1. Review of the current remedy goals and measurements: The remedy goals may be expressed in the ROD as remedial action objectives (RAOs) and preliminary remediation goals (PRGs). RAOs provide a general description of what the cleanup will accomplish (e.g., restoration of ground water). PRGs are the more specific statements of the desired endpoint concentrations or risk levels, for each exposure route, that are believed to provide adequate protection of human health and the environment.	
List the intermediate system goals (RAOs and PRGs).	
List the final system goals (RAOs and PRGs).	
What metrics (performance criteria) are being implemented to measure project progress towards meeting each goal?	
What schedule has been established for measuring and reporting each metric?	
Based on new information or events since the last review, is there a need to re-evaluate the remedy goals? Note: this might be due to factors such as whether the regulatory framework has been revised, whether existing goals appear realistic, and if there have been changes to land use or ground water production near the site. If yes, identify the remedy goals that should be re-evaluated, the rationale, and any plans for re-evaluating the goals.	☐ Yes ☐ No
2. Review of changes to the CSM: The CSM for natural attenuation is the site-specific qualitative and quantitative description of the migration and fate of contaminants with respect to possible receptors and the geologic, hydrologic, biologic, geochemical and anthropogenic factors that control contaminant distribution. Because the CSM provides the basis for the remedy and monitoring plan, it can be reevaluated as new data are developed throughout the lifetime of the remedy. The following questions may be used to evaluate the need for updating the CSM:	
Have new contaminant sources been identified or have previously suspected contaminant sources been eliminated from further consideration since the last time you completed the O&M checklist for this remedy? If yes, use this space to comment.	☐ Yes ☐ No
Has there been an increase or decrease in size of the plume since the last time you completed an O&M checklist for this remedy? Comments (e.g., what is the nature and magnitude of the change).	☐ Increase ☐ Decrease ☐ No change
Has there been an increase or decrease in vertical extents of the plume since the last time you completed an O&M checklist for this remedy? Comments (e.g., what is the nature and magnitude of the change).	☐ Increase ☐ Decrease ☐ No change
Has there been an increase or decrease in the maximum contaminant concentrations in the plume since the last time you completed an O&M checklist for this remedy? Comments (e.g., have maximum concentrations changed for all or a subset of contaminants, which ones, and by how much).	☐ Increase ☐ Decrease ☐ No change
What types of reaction zone(s) are present in the plume (aerobic, anaerobic, or both)?	

Based on information collected since the last O&M review, is there a need to re-evaluate the number and/or location of monitoring points in the reaction zone(s)? If yes, use this space to comment.	☐ Yes ☐ No
Based on information collected since the last O&M review, is there a need to re-evaluate the number and/or location of monitoring points in the target zones? If yes, use this space to comment.	☐ Yes ☐ No
Has there been a change in ground water flow rate or direction that may suggest monitoring frequency or locations may need to be reevaluated? If yes, use this space to comment.	☐ Yes ☐ No
Is there evidence of periodic pulses of residual contamination from the vadose zone that suggest new monitoring points should be added in the vadose zone? If yes, use this space to comment.	☐ Yes ☐ No
If there is reason to re-evaluate the number and location of monitoring points and/or monitoring frequency (as indicated in above responses), identify any plans for re-evaluating the monitoring program.	
Based on your responses to the above questions, would it be useful to update the CSM at this time? If yes, please describe any plans to update the CSM.	☐ Yes ☐ No

B. Remedy Performance Assessment

1. Review performance monitoring objectives. The OSWER Directive 9200.4-17P (U.S. EPA, 1999a) provides eight specific objectives for the performance-monitoring program of an MNA remedy.

For each of the following eight performance monitoring objectives, identify which are currently being met, which are currently being met but could benefit from further review, and which are currently not being met.

Objective	Status		
	Being met	*Benefit from review*	*Not being met*
1) Demonstrate that natural attenuation is occurring according to expectations	☐	☐	☐
2) Detect changes in environmental conditions that may reduce the efficacy of any of the natural attenuation processes	☐	☐	☐
3) Identify any potentially toxic and/or mobile transformation products	☐	☐	☐
4) Verify that the plume(s) is not expanding downgradient, laterally or vertically	☐	☐	☐
5) Verify no unacceptable impact to downgradient receptors	☐	☐	☐
6) Detect new releases of contaminants to the environment that could impact the effectiveness of the natural attenuation remedy	☐	☐	☐
7) Demonstrate the efficacy of ICs that were put in place to protect potential receptors	☐	☐	☐
8) Verify attainment of remediation objectives	☐	☐	☐

If any of these objectives are not being met or would benefit from review, please describe (e.g., in what way is the objective not being met, why might the objective benefit from further review).

Describe any plans to review and/or change the location, frequency or types of samples and measurements to meet this (these) objective(s).

2. Evaluate remedy effectiveness: The following questions are intended to review whether the MNA remedy is performing as intended, or whether there may be a need to implement a contingency remedy. A contingency remedy is a cleanup technology or approach that functions as a backup remedy in the event that the selected remedy fails to perform as anticipated.	
Since the last O&M review, have contaminant concentrations in soil or ground water at specified locations exhibited an increasing trend not originally predicted during remedy selection?	☐ Yes ☐ No
Since the last O&M review, have near-source wells exhibited large concentration increases indicative of a new or renewed release?	☐ Yes ☐ No
Since the last O&M review, have contaminants been detected in monitoring wells located outside of the original plume boundary or other compliance-monitoring boundary?	☐ Yes ☐ No
Since the last O&M review, have analyses concluded that the rate of decrease of contaminant concentrations may be inadequate to meet the remediation objectives?	☐ Yes ☐ No
Since the last O&M review, have changes in land and/or ground water use been suggested and or implemented that have the potential to reduce the protectiveness of the MNA remedy?	☐ Yes ☐ No
Since the last review, have contaminants been identified in locations that pose or have the potential to pose unacceptable risk to receptors?	☐ Yes ☐ No
If you answered yes to any of the above questions, did the information suggest the need for immediate action or is the condition being monitored to evaluate the need for future action? Use this space to comment.	☐ Immediate action ☐ Monitored for future ☐ N/A
Based on your answers to the above questions, is there reason to evaluate the need for a contingent remedy at this time? If yes, use this space to comment.	☐ Yes ☐ No
3. Evaluate collection and analysis of performance monitoring data	
What evidence has been used to evaluate actual plume dissipation (e.g., temporal trends in individual wells, estimation of mass reduction, comparisons of observed contaminant distributions with predictions and required milestones, comparison of field-scale attenuation rates)?	
Since the last O&M review, has it been necessary to modify the site-specific plans (e.g., Sampling and Analysis Plan, Quality Assurance Project Plan, Data Management Plan) to account for new information and/or unforeseen circumstances? If yes, use this space to comment.	☐ Yes ☐ No
Does information collected since the last O&M review suggest the need to evaluate whether field parameters that are critical to an MNA evaluation (e.g., dissolved oxygen, redox potential) are being collected at appropriate monitoring points? If yes, use this space to comment.	☐ Yes ☐ No
Do the approaches used to interpret ground water monitoring data (e.g., concentration trend analyses, plume contour and/or bubble maps, plume cross-sections, potentiometric surface maps) provide adequate information to assess the performance of the natural attenuation remedy? If no, describe plans, if any, to implement new approaches.	☐ Yes ☐ No
Does information collected since the last O&M review suggest the need to re-evaluate the ground water and soil-monitoring program to more accurately delineate and monitor the plume boundary? If yes, use this space to comment.	☐ Yes ☐ No
Since the last O&M review, has it been necessary to modify the data quality assessment, including statistical tests (if appropriate), regression analysis, scatter plots, etc. to account for new information and/or unforeseen circumstances? If yes, use this space to comment.	☐ Yes ☐ No
Are ground water data managed electronically? If no, use this space to explain why not.	☐ Yes ☐ No

If statistical tests are used, do the data meet the assumptions of the statistical test?	☐ Yes ☐ No
If no, does this suggest the need to change the monitoring program or re-evaluate the statistical approach? Use this space to comment.	☐ Evaluate monitoring program ☐ Evaluate statistical approach ☐ Neither
Is high variability in the data interfering with or preventing a meaningful interpretation of the data?	☐ Yes ☐ No
If yes, could this situation be mitigated by increasing the density or frequency of sampling? Use this space to comment.	☐ Yes ☐ No
Are performance-monitoring reports of sufficient quality and frequency to evaluate the efficacy of MNA as a remedy and recognize protectiveness problems in time for effective action? If no, what actions, if any, have been taken or are planned to address this situation?	☐ Yes ☐ No
Are techniques or models being used to evaluate adequacy/redundancy of individual wells in the monitoring network, and adequacy/redundancy of sampling frequency? Note that techniques may range from statistical trend analysis to application of ~~a~~ decision support tool.	☐ Yes ☐ No
If no, are there plans to evaluate the adequacy/redundancy of individual monitoring wells and/or sampling frequency? Use this space to comment.	☐ Yes ☐ No
C. Cost Effectiveness: Key considerations in looking at cost-effectiveness of an MNA remedy are the list of parameters for monitoring, as well as the frequency and location of monitoring. Decreases in monitoring parameters, frequency or locations may be appropriate and allow for reductions in project monitoring costs. For example, decreases in monitoring frequency for certain parameters may be warranted if the remedy is proceeding according to expectations and trends are stable after evaluation of data from a sufficient number of monitoring periods (e.g., many years). To support such a decision, the available data generally cover a time period sufficient to allow for an evaluation of seasonal trends and other long-term cycles and trends.	
Does information collected since the last O&M review suggest opportunities to eliminate monitoring points (e.g., because of redundancy, unreliability, or changes in program objectives)? If yes, use this space to comment.	☐ Yes ☐ No
Does information collected since the last O&M review suggest opportunities to replace current analytical and sampling methods with less expensive methods and still meet the data quality objectives? If yes, use this space to comment.	☐ Yes ☐ No
Can the analyte list be shortened to focus on the known contaminants of concern?	☐ Yes ☐ No
D. Remedial Decisions: Following data evaluation, decisions are routinely made regarding the effectiveness of the MNA remedy, monitoring program, and ICs, and the need for contingency or alternative remedies. The following remedial decisions are discussed in Section 4 of the EPA guidance document *Performance Monitoring of MNA Remedies for VOCs in Ground Water* (EPA/600/R-04/027; April 2004). Indicate which of the following remedial decisions is appropriate at the present time and provide the basis for the decision.	
☐ No Change to the Monitoring Program ☐ Modify/Optimize Monitoring Program ☐ IC Modifications ☐ Implementation of Contingency/Alternative Remedy ☐ Terminate Performance Monitoring and Initiate Verification Monitoring	
Basis for decision:	

RECOMMENDED APPENDIX C. CONTAINMENT REMEDIES

The following checklist is an abbreviated set of questions that could be used by a EPA RPMs for an annual review of the O&M of a containment remedy and associated off-gas treatment system. This checklist focuses on engineered containment remedies, including landfill caps, covers, and vertical engineered barriers (VEB). Containment by other means such as hydraulic control and in-situ sediment containment remedies are not addressed by this appendix. See separate surface water/sediment remedy checklist for sediment remedies. Although the checklist includes items for off-gas systems, it focuses on off-gas collection. The checklist does not address off-gas management using combustion systems because such systems are uncommon at Superfund sites.

A. Remedy Description, Goals and Conceptual Site Model (CSM)

1. Review of the current remedy

Identify the containment systems in place:

- ☒ Cap/cover
- ☐ VEB
- ☐ Liner
- ☐ Landfill gas collection
- ☐ Landfill gas management
- ☐ Leachate detection
- ☐ Leachate collection
- ☐ Leachate management
- ☐ Other (Describe:)

Identify the O&M components:

- ☒ Inspection
- ☐ Monitoring
- ☐ Testing
- ☐ Ground water monitoring
- ☐ Surface water monitoring
- ☐ Landfill gas monitoring
- ☐ Vapor intrusion monitoring
- ☐ Leachate monitoring
- ☐ Other (Describe:)

2. Review of the current remedy goals

Identify the remedy goals (RAOs):

- ☒ Prevent direct contact with a contaminant source
- ☐ Prevent migration of a contaminant source to:
  - ☐ A drinking water aquifer
  - ☐ Surface water
  - ☐ Soil or other solid media☐
  - ☐ Air (via wind-borne material)
  - ☐ Air (via volatilization)
  - ☐ Other (Describe:)
- ☐ Prevent migration of contaminated ground water
- ☐ Prevent vapor intrusion or indoor air exposure
- ☐ Control off-gas
- ☐ Other remedy goals (Describe:)

What metrics (performance criteria) are being implemented to measure project progress towards meeting each goal?

What schedule has been established for measuring and reporting each metric?

Based on new information or events since the last O&M review, is there a need to re-evaluate the remedy goals? This might be due to factors such as whether the regulatory framework has been revised, whether existing goals appear to be realistic, and whether there have been changes in land use or ground water production near the site. If yes, identify the remedy goals that should be re-evaluated, the rationale, and any plans for re-evaluating the goals.	☐ Yes ☒ No

3. Review of changes to the CSM: The CSM for a containment remedy is the site-specific, qualitative and quantitative description of the migration and fate of contaminants with respect to possible receptors and the geologic, hydrologic, biological, geochemical and anthropogenic factors that control contaminant distribution. Because the CSM provides the basis for the remedy and the post-closure maintenance plan or O&M plan, the model should be re-evaluated as new data are collected throughout the lifetime of the remedy.	
Does new information gathered or conclusions reached since the last time the O&M checklist was completed indicate a change in understanding about the sources, types, migration, and fate of contaminants? *Note that indicators could include (1) the remedy not functioning as designed, (2) unexpected contaminants or contaminant concentrations above the required levels at the point of compliance, (3) unexpected trends in contaminant concentrations, (4) unexpected changes in the flow rate or direction of ground water, (5) unexpected changes in off-gas characteristics, or (6) unexpected evidence of vapor intrusion in nearby structures.*	☒ Yes ☐ No
Based on new information and/or conclusions, would it be useful to update the CSM at this time? If yes, please describe any plans to update the CSM. Site-wide risk assessment	☒ Yes ☐ No
B. Remedy Performance Assessment This section contains a series of questions that can be used to help assess a containment remedy's effectiveness and evaluate the collection and analysis of performance monitoring data. For each potential problem identified, an analysis should be performed to determine what, if anything should be done.	
1. Evaluate remedy effectiveness: The following questions are intended to review whether the containment remedy is performing as intended or whether there is a need to implement a contingency remedy. A contingency remedy is a cleanup technology or approach that functions as a backup remedy in the event that the selected remedy fails to perform as anticipated. A contingency remedy may be considered if there is a "yes" answer to one or more of the following three questions. *Note that additional measures and methods for evaluating the effectiveness of containment remedies can be found in "EPA/USACE Draft Technical Guidance for RCRA/CERCLA Final Covers" (EPA 540-R-04-007) and "EPA Comprehensive 5-Year Review Guidance, Appendix D, Five-Year Review Site Inspection Checklist" (OSWER Directive 9355.7-03B-P).*	
Since the last O&M review, has inspection or testing of the cap, cover, liner, or VEB indicated that the system is failing or could eventually fail?	☐ Yes ☒ No
Since the last O&M review, have changes in land, surface water, or ground water use been suggested and or implemented that have the potential to reduce the protectiveness of the containment remedy?	☐ Yes ☒ No
Since the last O&M review, have contaminants been identified in new locations or at higher concentrations where they pose or have the potential to pose unacceptable risks to receptors?	☐ Yes ☒ No
If you answered yes to any of the above questions, did the information suggest the need for immediate action or is the condition being monitored to evaluate the need for future action? Use this space to comment. What actions, if any, have been taken and/or are planned in response to the new information?	☐ Immediate action ☐ Monitored for future ☒ N/A
For VEB Only: Note that additional measures and methods for evaluating VEB effectiveness can be found in "EPA Evaluation of Subsurface Engineered Barriers at Waste Sites".	
Have bulk integrity tests been performed since the last O&M review?	☐ Yes ☐ No

If bulk integrity tests have been performed since the last review, do test results indicate that need to evaluate possible breaches or excessive leakage in the VEB over the short and long terms? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No ☐ N/A
Based on information collected since the last O&M review, do contaminant concentrations upgradient of the VEB indicate the need to evaluate actions to prevent possible contaminant migration? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No
Does information collected since the last O&M review suggest the need to evaluate hydraulic controls as an additional measure to control possible contaminant migration around the VEB (answer N/A if hydraulic controls are already part of the remedy)? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No ☐ N/A
For Off-Gas Collection Management Only: Note that additional measures and methods for evaluating off-gas collection and management effectiveness can be found in "USACE Landfill Off-Gas Treatment, Thermal Oxidation Checklist".	
Since the last O&M review for this system, have off-gas volume and composition been consistently within equipment design parameters? If no, what actions have been taken and/or are planned in response?	☐ Yes ☐ No
Since the last O&M review for this system, have off-gas system operational characteristics, such as required temperatures and pressures, been maintained within system design parameters? If no, what actions have been taken and/or are planned in response?	☐ Yes ☐ No
Since the last time an O&M checklist was completed for this system, have off-gas emissions met all federal, state, and local regulatory requirements? If no, what is being done to meet these requirements?	☐ Yes ☐ No
Based on information collected since the last O&M review, is there any evidence of unacceptable vapor intrusion in nearby structures? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No
Based on information collected since the last O&M review, have concentrations of off-gases inside buildings or at the site fence line suggested the need to assess safety and human health threats? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No
2. Evaluate collection and analysis of performance monitoring data Note that more detailed information about performance parameters can be found in the following documents: ▪ "EPA/USACE Draft Technical Guidance for RCRA/CERCLA Final Covers" (EPA 540-R-04-007) ▪ "EPA Comprehensive 5-Year Review Guidance, Appendix D, Five-Year Review Site Inspection Checklist" (OSWER Directive 9355.7-03B-P) ▪ "USACE Landfill Off-Gas Treatment, Thermal Oxidation Checklist" ▪ "EPA Evaluation of Subsurface Engineered Barriers at Waste Sites" (EPA 542-R-98-005; August 1998).	
Since the last O&M review, has it been necessary to modify planned inspections, sampling events, and sample analyses, as reflected in the site post-closure maintenance plan or O&M plans, to account for new information and/or unforeseen circumstances? If yes, use this space to comment.	☐ Yes ☐ No
Has information collected since the last O&M review suggested the need to re-evaluate whether performance parameters that are critical to evaluation of the containment remedy are being collected at appropriate monitoring points? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No

Are ground water and off-gas system monitoring data managed electronically? If no, use this space to explain why not.	☐ Yes ☐ No
Since the last O&M review, have monitoring data been analyzed to identify trends and their significance? If no, use this space to explain why not.	☐ Yes ☐ No
Is high variability in the data interfering with or preventing a meaningful interpretation of the data?	☐ Yes ☐ No
If yes, could this situation be mitigated by increasing the density or frequency of data collection? Use this space to comment.	☐ Yes ☐ No
Are inspection and performance monitoring reports of sufficient quality and frequency to evaluate the efficacy of containment as a remedy and recognize protectiveness problems in time for effective action? If no, what actions, if any, have been taken or are planned to address this situation?	☐ Yes ☐ No
C. Cost-Effectiveness	
If off-gas is currently being treated, can it be vented to the atmosphere without treatment in compliance with all applicable federal, state, and local regulations?	☐ Yes ☐ No ☐ N/A
If yes, has the possibility of discontinuing off-gas treatment been explored? Use this space to comment.	☐ Yes ☐ No ☐ N/A
If leachate is currently being collected and treated, is operation of the leachate system necessary for proper functioning of the containment system?	☐ Yes ☐ No ☐ N/A
If no, has the possibility of discontinuing leachate collection and treatment been explored? Use this space to comment.	☐ Yes ☐ No ☐ N/A
If hydraulic controls are being used in conjunction with a VEB, would the VEB provide passive containment without these controls?	☐ Yes ☐ No ☐ N/A
If yes, has the possibility of discontinuing the hydraulic controls been explored? Use this space to comment.	☐ Yes ☐ No ☐ N/A
D. Remedial Decisions: Indicate which of the following remedial decisions is appropriate at the present time and provide the basis for the decision.	
☒ No change to the remedy ☐ Modify or optimize remedy ☐ Modify or optimize O&M ☐ Modify ICs ☐ Implement contingency or alternative remedy ☐ Terminate inspections or monitoring	
Basis for decision:	

RECOMMENDED APPENDIX D. SOIL VAPOR EXTRACTION/AIR SPARGING REMEDIES

- The following checklist is an abbreviated set of questions that EPA RPMs could use when conducting an annual review of the O&M of a soil vapor extraction (SVE), air sparging (AS), or combined SVE/AS remedy. This checklist does not represent the level of review used in EPA's five-year review process to determine whether the remedy is or will be protective of human health and the environment. However, the checklist does contain review elements regarding the performance of SVE and/or AS remedies that are consistent with the comprehensive five-year review process.

A. Remedy Description, Goals and Conceptual Site Model (CSM)

1. Review of the current remedy

Identify the current remedy:

- ☐ SVE
- ☐ AS

How many extraction wells or trenches are used for SVE (if applicable)?

How many injection wells are used for AS (if applicable)?

2. Review of the current remedy goals

List the remedy goals (RAOs):

- ☐ Prevent migration of a contaminant source to:
  - ☐ A drinking water aquifer
  - ☐ Surface water
  - ☐ Soil or other solid media
- ☐ Prevent migration of contaminated ground water
- ☐ Restore ground water
- ☐ Other (Describe:)

List the short-term objectives and intermediate system goals.

List the long-term soil and ground water cleanup goals.

What metrics (performance criteria) are being implemented to measure project progress towards meeting each goal?

What schedule has been established for measuring and reporting each metric?

Based on new information or events since the last O&M review, is there a reason to re-evaluate the remedy goals? Note that this might be due to factors such as whether the regulatory framework has been revised, whether existing goals appear to be realistic, and whether there have been changes in land or ground water use near the site. If yes, identify the remedy goals that should be re-evaluated, the rationale, and any plans for re-evaluating the goals.	☐ Yes ☐ No

3. Review of changes to the CSM: The CSM for a SVE/AS remedy is the site-specific, qualitative and quantitative description of the migration and fate of contaminants with respect to possible receptors and the geologic, hydrologic, biological, geochemical and anthropogenic factors that control contaminant distribution. Because the CSM provides the basis for the remedy and the O&M plan, the model should be re-evaluated as new data are collected throughout the lifetime of the remedy.	
Does new information gathered or conclusions reached since the last time the O&M checklist was completed indicate a change in understanding about the sources, types, migration, and fate of contaminants? *Note that indicators could include: (1) the remedy not functioning as designed, (2) unexpected contaminants or contaminant concentrations above the required levels at the point of compliance, (3) unexpected trends in contaminant concentrations, (4) unexpected changes in the flow rate or direction of ground water, (5) unexpected changes in off-gas characteristics, (6) unexpected evidence of vapor intrusion in nearby structures; or (7) identification of new sources.*	☐ Yes ☐ No
Based on new information and/or conclusions, would it be useful to update the CSM at this time? If yes, please describe any plans to update the CSM.	☐ Yes ☐ No
B. Remedy Performance Assessment This section contains a series of questions that can be used to help assess a SVE/AS remedy's effectiveness and evaluate the collection and analysis of performance monitoring data.	
1. Evaluate remedy effectiveness: The following questions are intended to review whether the SVE/AS remedy is performing as intended, or whether there is a need to implement a contingency remedy. A contingency remedy is a cleanup technology or approach that functions as a backup remedy in the event that the selected remedy fails to perform as anticipated. A contingency remedy may be considered if there is a "yes" answer to either of the following five questions.	
Based on information collected since the last O&M review, do monitoring data indicate that the system is failing or could eventually fail to meet remedy goals?	☐ Yes ☐ No
Since the last O&M review, has the areal extent of contamination (or plume) increased in a manner not originally predicted during remedy selection?	☐ Yes ☐ No
Since the last O&M review, have monitoring data exhibited trends indicative of a new or renewed release?	☐ Yes ☐ No
Since the last O&M review, have changes in land and/or ground water use been suggested and or implemented that have the potential to reduce the protectiveness of the SVE/AS remedy?	☐ Yes ☐ No
Since the last O&M review, have contaminants been identified in new locations or at higher concentrations where they pose or have the potential to pose unacceptable risks to receptors?	☐ Yes ☐ No
If you answered yes to any of the above questions, did the information suggest the need for immediate action or is the condition being monitored to evaluate the need for future action? Use this space to comment. What actions, if any, have been taken and/or are planned in response to the new information?	☐ Immediate action ☐ Monitored for future ☐ N/A
Based on your answers to the above questions, is there reason to evaluate the need for a contingent remedy at this time? If yes, use this space to comment.	☐ Yes ☐ No

Blowers and Piping	
Since the last O&M review for this system, has evidence of excessive corrosion of system components been observed? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No
Since the last O&M review, if blowers are operated intermittently, do VOC concentrations increase after they are shut off? How has this information been interpreted and what actions, if any, have been taken and/or are planned in response?	☐ Yes ☐ No ☐ N/A
Since the last O&M review, have blower operational characteristics, such as flow rate, pressure, and discharge temperatures, been consistently within equipment design parameters? If no, what actions have been taken and/or are planned in response?	☐ Yes ☐ No
Since the last O&M review, if water is manually removed from the extraction blower water separator, has water accumulation been observed that could adversely impact blower operation? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No ☐ N/A
Since the last O&M review, have all blowers, water separators, valves, and piping components been consistently operational?	☐ Yes ☐ No
Has the downtime associated with non-routine operations and maintenance of the blowers since the last time you completed an O&M checklist for this system exceeded expectations? If yes, what have been identified as the causes? If yes, what corrections have been or are being made to minimize downtime?	☐ Yes ☐ No
Does the operational history suggest that the preventative maintenance plan for the blowers needs to be re-evaluated? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No

Soil Vapor Extraction System	
Identify the SVE system characteristics, if any, that have deviated consistently/frequently from operational expectations since the last time an O&M checklist was completed for this system: ☐ Vapor flow rates at one or more extraction wells ☐ Vapor compositions (VOCs, CO_2, O_2) at one or more extraction wells ☐ Pressures at one or more extraction wells ☐ Flow at blower (prior to entry of any dilution air if used) ☐ Accumulation of water in the water separator	
Does this (do these) deviation(s) indicate a new condition since the last O&M review or an ongoing trend?	☐ New condition ☐ Ongoing trend ☐ N/A
What has been identified as the cause for this (these) deviation(s)?	
What actions, if any, have been or are being taken in response to this (these) deviation(s)?	
Based on information collected since the last O&M review, is there any evidence of unacceptable vapor intrusion in nearby structures? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No

Since the last O&M review, have gas concentrations in the blower discharge been running close enough to the lower explosive limit (LEL) or shown an increasing trend that suggests the need for action? *Note that specific compound LEL data are available in many chemistry texts as well as National Fire Protection Agency guidelines.* What actions, if any, have been taken and/or are planned in response to the new information?	☐ Yes ☐ No
Air Sparging System	
Since the last O&M review of the AS system, have flow rates at each injection well been consistently maintained within system design parameters? If no, what actions, if any, have been or are being taken in response?	☐ Yes ☐ No
Based on information collected since the last O&M review, have dissolved oxygen concentrations been maintained at a level sufficient to promote biological activity? If no, what actions, if any, have been or are being taken in response?	☐ Yes ☐ No
Since the last O&M review, are measured dissolved oxygen concentrations consistently indicative of good air/water contact rates (i.e., are concentrations near saturation)? If no, what actions, if any, have been or are being taken in response?	☐ Yes ☐ No
VOC Control System	
If the SVE system contains a VOC control device, has the device consistently met performance and compliance monitoring requirements (e.g., total VOC emission limits, specific compound limits, monitoring, air permit) since the last O&M review for this system? If no, what actions have been taken and/or planned in response?	☐ Yes ☐ No ☐ N/A
Since the last O&M review, has the VOC control system consistently meet required destruction and removal efficiencies? If no, what actions have been taken and/or planned in response?	☐ Yes ☐ No
Since the last O&M review, have any violations of air permits been reported? If yes, what has been or is being done to meet permit requirements?	☐ Yes ☐ No
Since the last time you completed an O&M checklist for this system, has the VOC control system been responsible for downtime associated with non-routine operations and maintenance? If yes, ▪ What was (were) the cause(s) for unplanned shutdown(s)? ▪ What has been done or is being done to minimize future downtime?	☐ Yes ☐ No
Thermal Oxidizers	
Since the last O&M review for this system, have the operational characteristics (e.g., LEL history of feed gas, operating temperature, inlet flow, oxygen level in flue gas, fuel use) been consistently within equipment design parameters? If no, what actions, if any, have been or are being taken in response?	☐ Yes ☐ No ☐ N/A
Since the last O&M review, has there been any indication of improper operation of flashback protection equipment (e.g., detonation arrestor, sealed drum)? If yes, what actions have been taken and/or planned in response?	☐ Yes ☐ No
Since the last O&M review, has there been any indication of improper operation of safety interlocks (e.g., high LEL, high oxidizer temperature, loss of flame, low fuel pressures)? If yes, what actions have been taken and/or planned in response?	☐ Yes ☐ No
If acid gases are present, have scrubber operations (e.g., scrubber liquid flow and pH, caustic use,	☐ Yes

scrubber blowdown and its treatment) been consistent with operational expectations since the last O&M review? If no, what actions have been taken and/or planned in response?	☐ No
Carbon Adsorbers	
Does the unit have humidity controls?	☐ Yes ☐ No
Since the last O&M review for this system, have the operational characteristics (e.g., relative humidity data at adsorber inlet, adsorber operating temperature, carbon breakthrough, carbon change out history, operating velocity through adsorbers, adsorber discharge VOC data) been consistently within equipment design parameters? If no, what actions, if any, have been or are being taken in response?	☐ Yes ☐ No ☐ N/A
Other Control Devices	
Since the last O&M review for this system, have the operational characteristics (e.g., biofiltration media surface loading rate, temperature controls, nutrient addition rate) been consistently within equipment design parameters? If no, what actions, if any, have been or are being taken in response?	☐ Yes ☐ No ☐ N/A
2. Evaluate collection and analysis of performance monitoring data	
Since the last O&M review, has it been necessary to modify sampling frequency relative to the original O&M plan to account for new information and/or unforeseen circumstances? If yes, use this space to comment.	☐ Yes ☐ No
Does soil and/or ground water data collected since the previous O&M review (e.g., VOCs concentrations, ground water elevations) suggest the need to re-evaluate other aspects of the monitoring program (e.g., monitoring locations, test parameters) to account for new information/unforeseen circumstances? If yes, use this space to comment.	☐ Yes ☐ No
C. Cost Effectiveness: Key considerations in looking at cost-effectiveness are the O&M costs incurred relative to design and reduction in VOC removal rates. Opportunities to reduce costs can be potentially found in the following areas:	
Does information collected since the last O&M review suggest that flows could be redistributed to speed overall remediation (i.e., reduce or eliminate flow to/from wells where removals have reached near asymptotic conditions or where cleanup goals have been achieved)? Use this space to comment.	☐ Yes ☐ No
Does information collected since the last O&M review show evidence of diffusion-limited VOC movement?	☐ Yes ☐ No
If yes, has the idea of modifying operation to pulsing (intermittent) been considered to speed overall remediation? Use this space to comment.	☐ Yes ☐ No
Does information collected since the last O&M review show reduced VOC removal rates that might warrant a reduction in monitoring frequencies? Use this space to comment.	☐ Yes ☐ No
Does information collected since the last O&M review suggest that VOC recovery rates have been reduced to the extent that the VOC control device can be eliminated? Use this space to comment.	☐ Yes ☐ No ☐ N/A
Does information collected since the last O&M review suggest that an alternative, lower cost VOC control	☐ Yes

device could be used? Use this space to comment.	☐ No
Does information collected since the last O&M review suggest that operation of the VOC control device could be modified to reduce costs, e.g., operate thermal oxidizer at lower temperatures or lower dilution air flows (e.g., when LEL basis no longer requires design flow) or use larger carbon beds to reduce carbon supplier charges for change outs? Use this space to comment.	☐ Yes ☐ No
Has maintenance history since the last O&M review identified high-maintenance equipment that could be replaced? Use this space to comment.	☐ Yes ☐ No

E. Remedial Decisions: Indicate which of the following remedial decisions are appropriate at the present time and provide a basis for each decision:

- ☐ Continue current remedy
- ☐ Goals have been achieved -- system can be shutdown in favor of MNA
- ☐ Modify/optimize remedial system(s) – use intermittent operation; optimize flows to/from wells to promote increased removals; increase use of sparging to promote biodegradation; add new wells if contaminant movement is indicated to areas currently not being influenced; implement cost reduction measures; conduct more detailed evaluation of the contaminated zone using a tool such as Pneulog.
- ☐ Modify/optimize O&M – increase monitoring to provide additional data for more definitive assessment at the next review
- ☐ Modify ICs
- ☐ Implement contingent or alternative remedy

Basis for decision:

RECOMMENDED APPENDIX E. OTHER REMEDY TYPES/COMPONENTS

The following checklist is a set of questions that may be used by EPA RPMs for an annual review of the O&M of remedies and remedy components that are not addressed in Appendices A through D or the separate surface water/sediment remedy O&M checklist. This could include remedies/components that involve a technology that is not covered in these other materials or remedies/components where the O&M can be more efficiently reviewed using the more streamlined questions below. If the site includes multiple remedy components that are not covered elsewhere, multiple copies of this appendix, each applying to a different component or related set of components, could be completed.

A. Remedy Description and Goals

1. Review of current remedy goals, and measurements

The following questions can be used to document basic information about the remedy and remedy goals to provide context for the remainder of the information in this appendix.

Identify the remedy component(s) and associated systems and technologies being covered on this form:	
What are the intermediate and final system goals?	
What metrics (performance criteria) are being implemented to measure project progress towards meeting each goal?	
What schedule has been established for measuring and reporting each metric?	
Based on new information or events since the last O&M review of this system/technology, is there a need to re-evaluate the remedy goals? If yes, identify the remedy goals that should be re-evaluated, the rationale, and any plans for re-evaluating the goals.	☐ Yes ☒ No

2. Review of changes to the CSM

The following questions ask about changes in contamination and other field conditions that could affect the monitoring program, system operations, and other aspects of O&M. They provide context for questions in subsequent sections that ask whether action should be taken to modify the O&M program.

Do monitoring data indicate trends/patterns that are inconsistent with the CSM (or similar conceptual understanding of site conditions) that was used as the basis for design of the remedy/remedial component(s)? If yes, use this space to comment.	☐ Yes ☒ No
Have there been changes in field conditions (e.g., change in land/water use) that differ significantly from the conditions incorporated in the CSM (or similar conceptual understanding of site conditions) that was used as the basis for design of the remedy/remedial component(s)? If yes, use this space to comment.	☐ Yes ☒ No
Have new contaminant sources been identified? If yes, please describe the new sources and how they are they being addressed:	☐ Yes ☒ No

B. Remedy Performance Assessment

This section contains a series of questions that can be used to help assess whether the monitoring program and remediation systems O&M should be adjusted.

1. Monitoring Program

Describe changes to the monitoring program that have been made since the last time you completed the O&M checklist for this remedy component.	
Are the baseline data and post-remedy data adequate to perform statistical comparisons and evaluate remedy performance? If no, what actions have been or are being taken in response?	☒ Yes ☐ No

Is high variability in the data interfering with or preventing a meaningful interpretation of the data?	☐ Yes ☐ No
If yes, could this situation be mitigated by increasing the density or frequency of data collection? Use this space to comment.	☐ Yes ☐ No
Based on changes in contamination or field conditions (see A.2 of this appendix), is there reason to modify the monitoring program? If yes, describe changes to the monitoring program that are most necessary.	☐ Yes ☒ No
Has the adequacy/redundancy and cost-effectiveness of the monitoring program been evaluated, including evaluation of sampling locations, frequency, sampling and analytical methods, monitoring parameters, and test methods? Use this space to comment.	☒ Yes ☐ No
Is there reason to modify the monitoring program to address inadequacies, remove redundancies, and/or improve its cost-effectiveness? If yes, describe changes to the monitoring program that would likely have the greatest impact.	☐ Yes ☒ No
Do you have adequate documentation (e.g., good quality O&M reports) and tools (e.g., software) to effectively manage and interpret monitoring data? If no, please explain how documentation and/or tools could be improved.	☒ Yes ☐ No
2. System Operations	
Describe changes to system operations that have been made since the last time you completed the O&M checklist for this remedy component. No changes	
Is (are) the remedial system(s) covered under this appendix performing as expected relative to the remediation milestones and goal(s)? If no, what actions have been or are being taken in response?	☒ Yes ☐ No
Do monitoring data indicate trends/patterns that are consistent with remedial design expectations? If no, what actions have been or are being taken in response?	☒ Yes ☐ No
Based on observations regarding contamination or field conditions (see A.2 of this appendix and previous questions in this section), is there reason to modify systems operations to improve remedy performance? If yes, describe changes to system operations that are most necessary.	☐ Yes ☒ No
Has an optimization study been conducted for the remedy/remedy component(s)? Use this space to comment.	☐ Yes ☐ No
Has the downtime associated with non-routine operations and maintenance exceeded expectations? If yes, what actions have been or are being taken to minimize downtime?	☐ Yes ☒ No
Based on optimization and downtime considerations, is there reason to modify systems operations to improve remedy performance? If yes, describe changes to system operations that are most necessary.	☐ Yes ☒ No
3. Maintenance	
Are routine maintenance activities adequate to ensure the reliable operation of the remedial system(s)? If no, what changes to the maintenance program are most necessary?	☒ Yes ☐ No

Have any major repairs to the remedial system(s) been required since the last time you completed the O&M checklist for this remedy/remedy component? If yes, describe the repairs, their impact on progress toward remediation milestones, and actions taken to minimize similar repairs in the future.	☐ Yes ☒ No
C. Cost Effectiveness	
Does information collected since the last O&M review suggest opportunities to reduce costs associated with equipment operations and maintenance? If yes, use this space to comment.	☐ Yes ☒ No
Does information collected since the last O&M review suggest opportunities to reduce costs associated with the monitoring program? If yes, use this space to comment.	☐ Yes ☒ No
D. Remedial Decisions: Indicate which of the following remedial decisions is appropriate at the present time and provide the basis for the decision.	
☒ No Change ☐ Modify/Optimize System ☐ Modify/Optimize Monitoring Program ☐ Modify ICs ☐ Implement Contingency/Alternative Remedy	
Basis for decision:	

Appendix D: Erosion Repair

Flyway erosion

Erosion matting: hay bales in place

Erosion matting: hay bales placed along the river

Another view of hay bale placement

Underbrush removal

Flyway erosion, river view

New fill over erosion area

New fill in place, ready for coconut matting

Erosion area, coconut matting in place

Another view of coconut matting in place

Erosion area repaired and seeded

Another seeded area